

Supplementary Materials for: Task-free spectral EEG
dynamics track and predict patient recovery from severe
acquired brain injury

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SUPPLEMENTARY RESULTS AND FIGURES

Ruling out participant age as a confound in classification analyses

Because of the heterogeneous age distribution of our patient sample, and given that spectral activity has been reported to change across lifespan (van Albada et al., 2010), it is conceivable that patient age was driving the classification analyses. To rule out this possibility, we correlated participant age at the time of measurement with the classifier's graded output (i.e. the weighted posterior probability that the classifier assigned to each patient, indicating the classifier's estimated likelihood that the patient belonged to a particular group).

If patient age was driving the classifier's performance when distinguishing UWS from MCS participants (Fig 4A in the main text), then participant age should significantly correlate with the classifier's graded output. However, age and classifier output did not correlate significantly across the full patient sample ($r = 0.007$, $p = 0.98$), across UWS patients alone ($r = 0.22$, $p = 0.54$), or across MCS patients ($r = -0.12$, $p = 0.75$). Thus, patient age did not drive the performance of the classifier that distinguished UWS from MCS patients.

Similarly, to rule out that patient age was driving the classifier that most accurately predicted the patient outcome scores (Fig 6B in the main text), we correlated participant age with the classifier's assigned likelihood of each group, and found no significant effects (UWS: $r = -0.09$, $p = 0.74$; MCS: $r = -0.15$, $p = 0.58$; eMCS: $r = 0.30$, $p = 0.27$), thus ruling out age as a confound in the classification analyses.

Exploring classification performance using EEG electrode-specific metrics

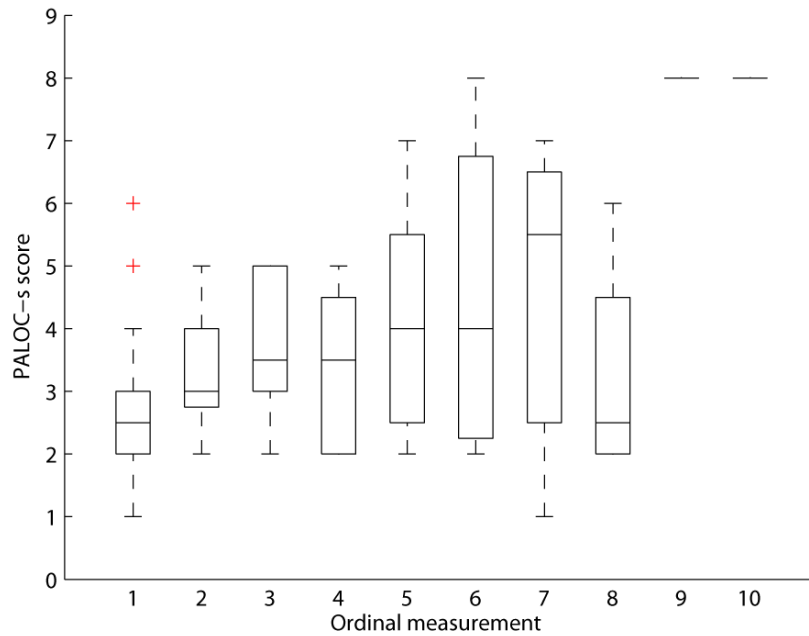
To explore the contribution of individual EEG electrodes to the overall results, we used the frequencies that yielded the highest classification accuracy when used for classification at the global level

(see Results section in the main text). To produce electrode-specific connectivity metrics, we averaged the connectivity seeded from of each individual electrode, within each frequency band of interest.

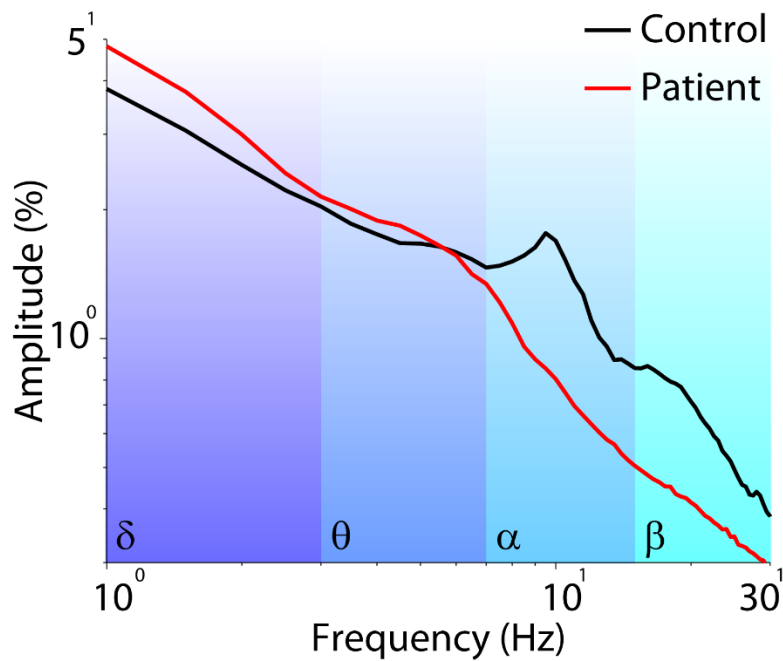
We found that the accuracy for none of the classifications based on individual electrodes exceeded the accuracy of classification that was based on global (brain-wide) metrics: Classification distinguishing patients from controls was most accurate for electrode C4 (~94% accurate); Classification distinguishing UWS from MCS patients was most accurate for electrode F4 (75% accurate); Classification that predicted the expected level of patient recovery was most accurate for electrodes Cz and C3 (both ~38% accurate).

Supplementary Table 1. Post-Acute Level of Consciousness Scale (PALOC-s)

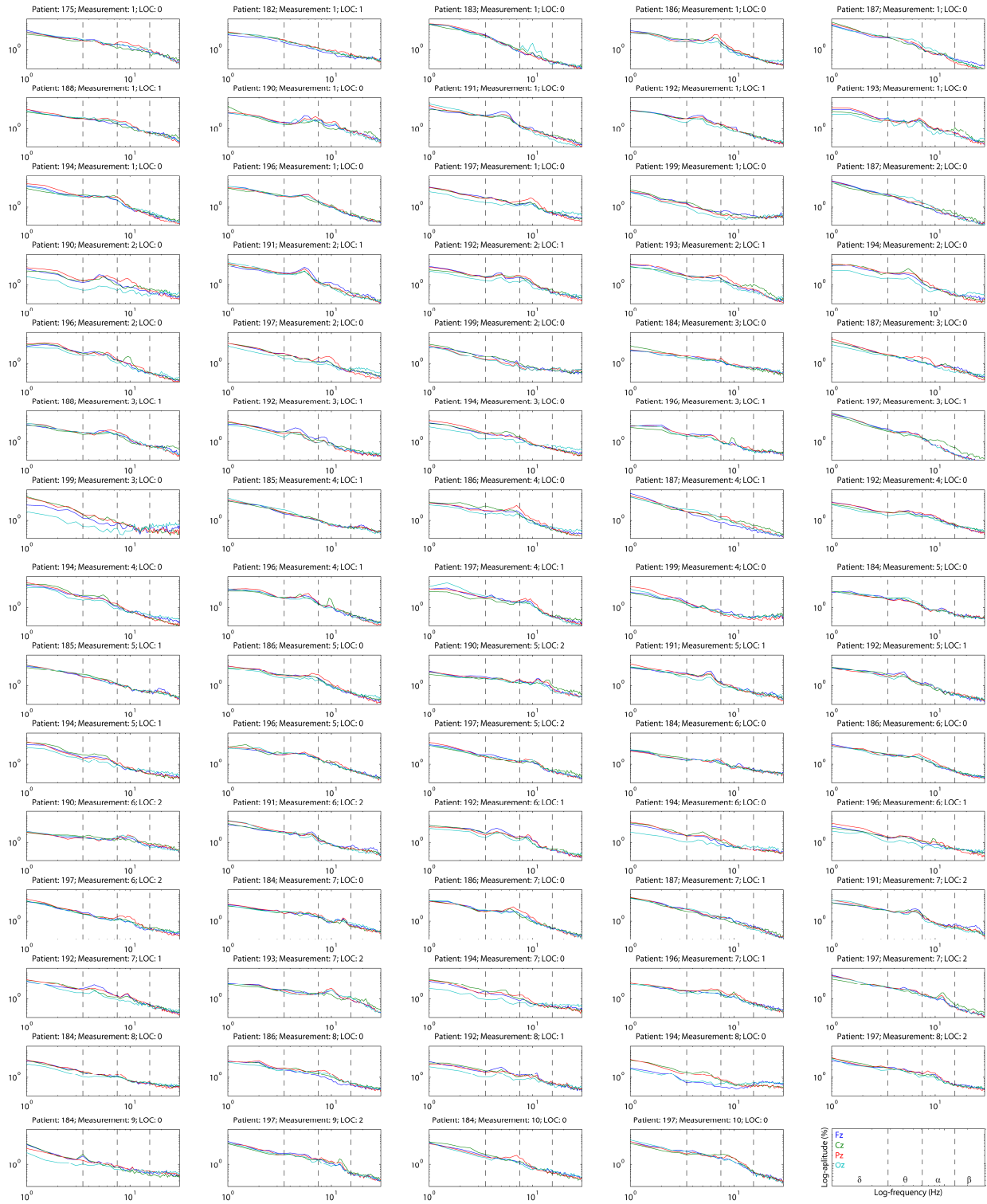
Global Level	PALOC Score	Description of the levels
Coma		Eyes are closed all the time. No sleep-wake cycles present.
	1	All mayor body functions such as breathing, temperature control, or blood pressure can be disturbed. Generally, no reactions are noticed after stimulation. Sometimes reflexes (stretching or flexing) can be observed as a reaction when strong pain stimuli have been applied. No other reactions present.
LOC 1 Unresponsive wakefulness syndrome (UWS) / Vegetative state		Patient has some sleep-wake cycles, but no proper day-night rhythm. Most of the body functions are normal. No further ventilation is required for respiration.
	2	Very little response (hyporesponsive)
	3	Generally no response after stimulation. Sometimes delayed presentation of reflexes is observed. Reflexive state Often stimuli result in massive stretching or startle reactions, without proper habituation. Sometimes these reactions evaluate into massive flexing responses. Roving eye movements can be seen, without tracking. Sometimes grimacing occurs after stimulation.
LOC 2 Minimally conscious state (MCS)	4	High active level and/or reactions in stimulated body parts Generally spontaneous undirected movements. Retracting of a limb following stimulation. Orienting towards a stimulus, without fixating. Following moving persons or objects, without fixating.
	5	Transitional state Following and fixating of persons and objects. Generally more directed reactions to stimuli. Behaviour is automatic, i.e. opening of the mouth when food is presented, or reaching towards persons or objects. Sometimes emotional reactions are seen such as crying or smiling towards family or to specific (known) stimuli.
	6	Inconsistent reactions Sometimes, but not always, obeying simple commands. Totally dependent. Patient has profound cognitive limitations; neuropsychological testing is impossible. Level of alertness is fluctuating, but in general low.
LOC 3 Exit from MCS (eMCS) / Conscious state	7	Consistent reactions Patient obeys simple commands. The level of alertness is high and stable. Many cognitive disturbances remain. Patient is totally dependent.
	8	Patient is alert and reacts to his/her environment spontaneously. Functional understandable mutual communication is possible, sometimes with technical support. As yet, cognitive and behavioural disturbances can be present.



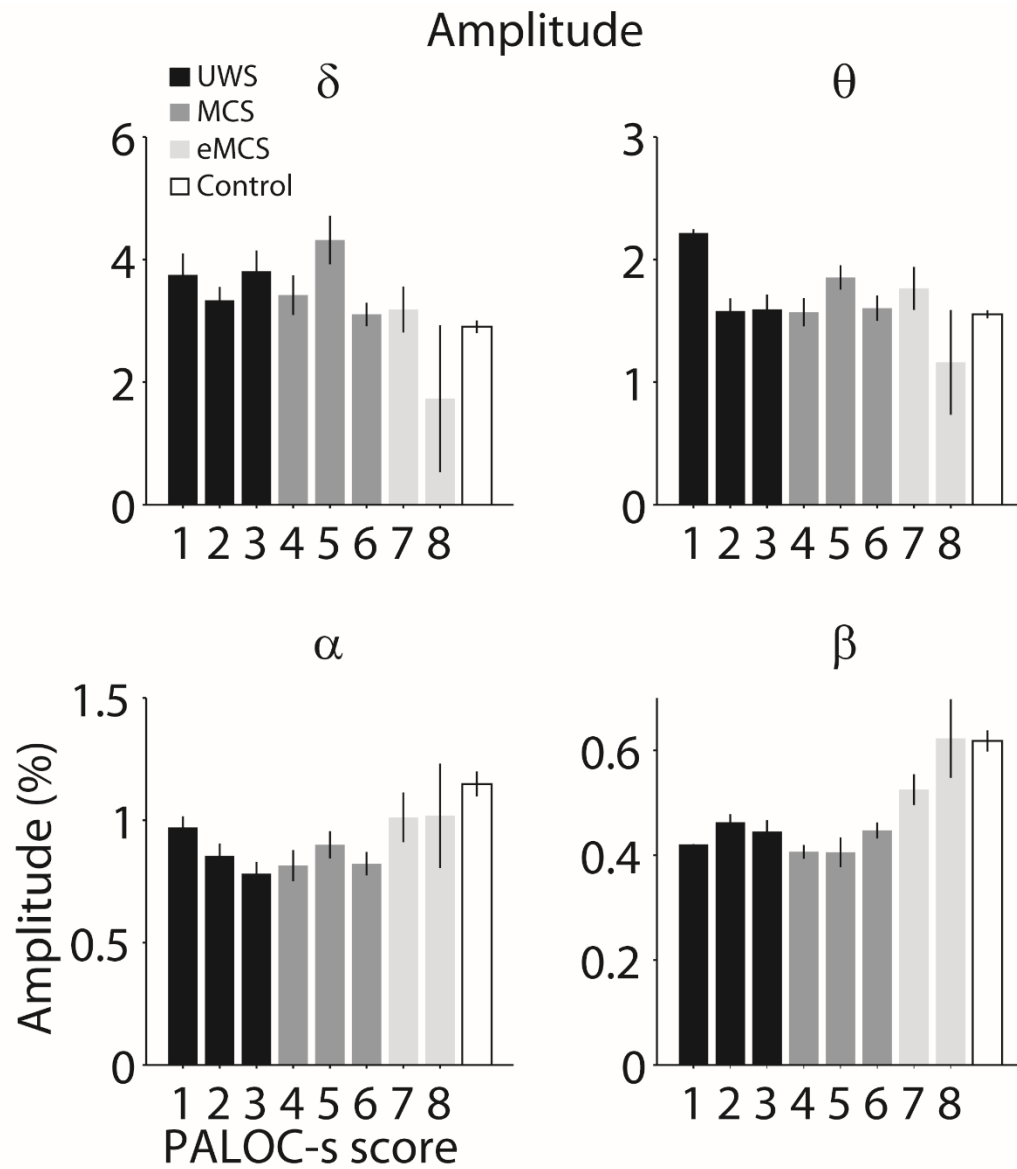
Supplementary Fig. 1. Boxplots of PALOC-s score per measurement. Horizontal lines display the median. Boxes denote a 95% confidence interval around the mean. Whiskers extend to the most extreme non-outlier cases. Outliers are shown in red.



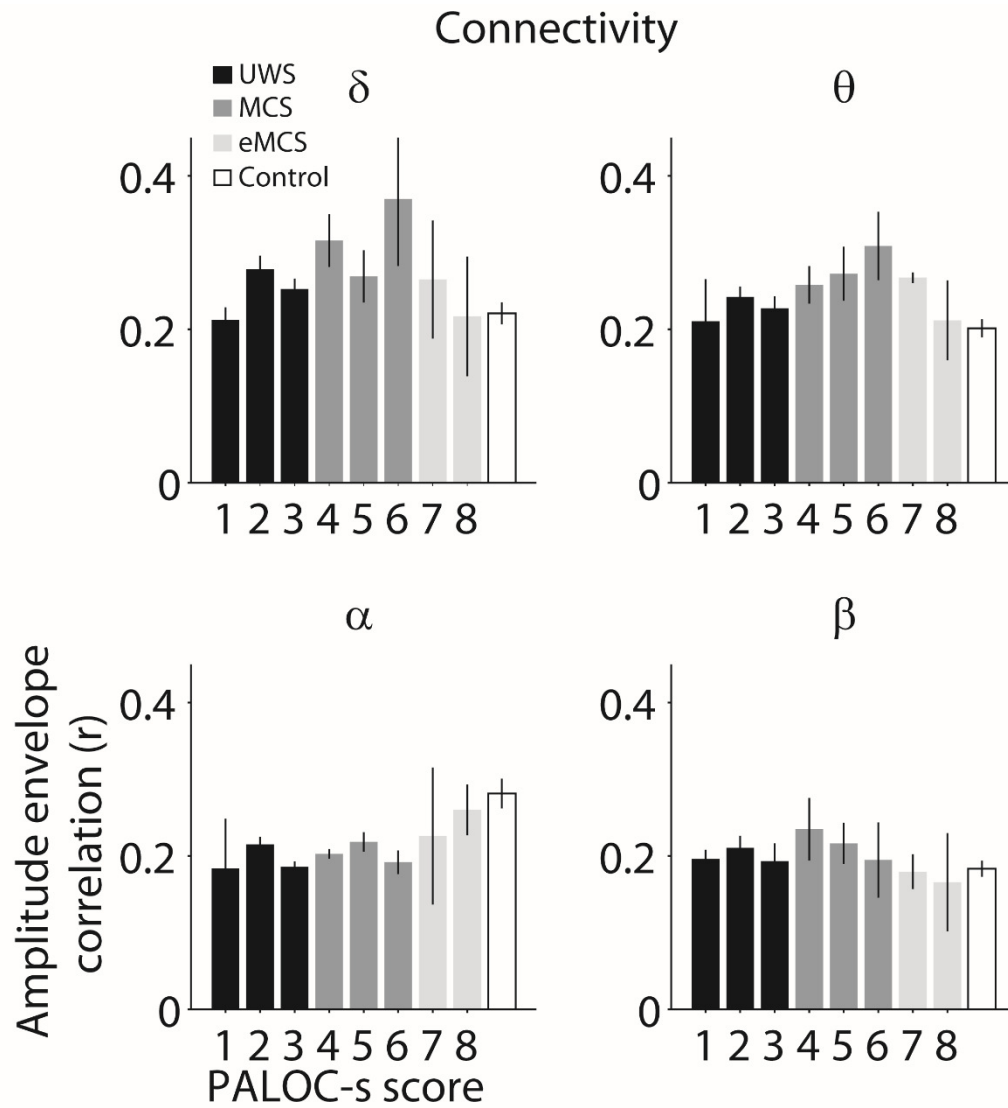
Supplementary Fig. 2. Log-plot of the global spectral amplitude for patients and control participants. Shaded areas indicate the different frequency bands.



Supplementary Fig. 3. Log-plots of midline channel-specific spectral amplitude for all recordings and all patients. LOC: level of consciousness; 0 = UWS; 1 = MCS; 2 = eMCS. The correspondence between line colors and EEG channels is shown in the lower right panel.



Supplementary Fig. 4. Amplitude per frequency band and level of consciousness. Error bars denote the SEM. PALOC-s: Post-Acute Level of Consciousness scale.



Supplementary Fig. 5. Connectivity per frequency band and level of consciousness. Error bars denote the SEM. PALOC-s: Post-Acute Level of Consciousness scale.

SUPPLEMENTARY REFERENCES

van Albada, S.J., Kerr, C.C., Chiang, A.K., Rennie, C.J., Robinson, P.A., 2010. Neurophysiological changes with age probed by inverse modeling of EEG spectra. *Clin Neurophysiol* 121, 21-38.